TG: @Chalnaayaaar

04 Environmental Issues

1. Introduction :

- "Any undesirable change in physical, chemical or biological characteristic of air, water and land which is harmful to the man directly or indirectly through his animals, plants, industrial units or raw materials is called **pollution**".
- **Pollutants** :- "Any material or act on the part of man, or nature which leads to pollution is called pollutants."

Some categories of pollutants:

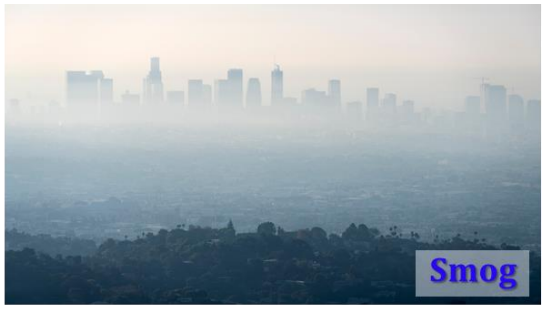
- **Nonbiodegradable pollutants :-** Many of such pollutants are usually not degraded or degraded partially in environment. Such as aluminium packs, Mercury compounds, Iron, Compounds of phenols, Glass, D.D.T. benzene, BHC pesticides, etc.
- They are collected in the environment and cause pollution. These pollutants are harmful even in low concentration and harm increases with their increasing concentration. No treatment is found in the nature for their recycling. There are two methods by which we can stop the pollution caused by pollutants
- Such type of substances should be banned by law.
- Use their alternative substances.

- **Biodegradable pollutants –** If much of domestic sewage papers, woods, garbage, live stock wastes, etc. are easily degraded completely by microorganisms, it becomes useful. But if these materials enter the environment in such large quantities, that they cannot be degraded completely then addition of these materials causes pollution in environment.

- **Primary pollutants –** These persist in the form in which they are added to the environment. ***e.g.*** DDT, CO etc.

TG: @Chalnaayaaar

- **Secondary pollutants –** These are formed by chemical reaction among primary pollutants
  e.g. Photochemical smog, London smog, PAN, O_3 etc.



  - Process of formation of secondary pollutants is known as **synergism**. secondary pollutants are more toxic than primary pollutants.
- **Quantitative pollutants –** These are the substances which occur in nature but become pollutant when their concentration reaches beyond a threshold value in the environment
  e.g. CO_2, Nitrogen Oxide etc.
- **Qualitative pollutants –** These are the substances which do not occur in the environment but are passed in through human activity
  e.g. fungicides, herbicides, D.D.T., etc.

Other type of pollution :

- **Natural pollution –** Caused by natural sources like, CH_4 from paddy fields and cattle, marsh, forest fire.
- **Anthropogenic pollution –** Caused by human activities.
- **Negative pollution –** Loss of soil productivity. ***e.g.***, Overgrazing, Soil erosion.
- Removal or absence of desirable substances at right place which results in loss of soil productivity.
- **Positive pollution –** Presence or addition of undesirable substances at wrong place which results in reduction of soil fertility ***e.g.*** more use of fertilizer, Land filling by wastes.

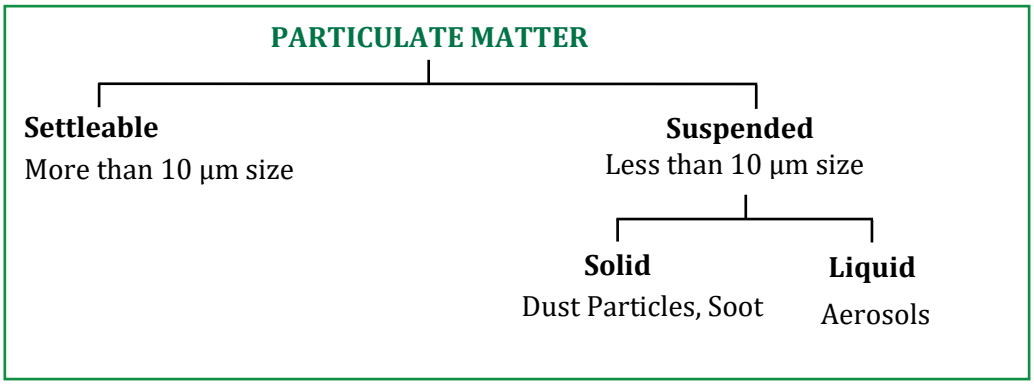
2. Air Pollution :

The air pollution is caused due to addition of unwanted substances or gases. The atmospheric pollution is mainly caused by the activities of man and concentrated to the inhabited and the industrial complexes in cities. There are two main categories of air pollutants

Gases : The gaseous materials include various gases and vapours of volatile substances or the compound with a boiling point below 200^0C.

Particulates : According to **central pollution control board (CPCB),** particulate size **2.5 micrometers** or less in diameter are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory problems, irritation, inflammation and damage to the lungs and premature deaths.

TG: @Chalnaayaaar



(A) Major Air Pollutants and their Effects :-

S.N.	Pollutant	Source	Effect
1.	**Carbon monoxide (CO)**	smoke of automobile and burning of fossil fuels (Petrol, diesel, coal)	it impairs **respiration** and it causes death due to **asphyxiation** when inhaled in large amount.
2.	**Unburnt Hydrocarbons (3,4 Benzopyrine, Benzene)**	automobiles and burning of fossil fuel (petrol, diesel, coal). Methane (CH_4) is the most abundant hydrocarbon in atmosphere and its main source is **marshy area** and **paddy field**.	Hydrocarbons causes **lung cancer**.
3.	**Ethylene**	Ethylene released in air during **fruits ripening**.	Falling of leaves without particular reason, falling of flowering bud before time.
4.	**Nitrogen oxide - (NO, NO_2)**	Burning (combustion) of fossil fuel in automobiles.	These nitrogen oxides form **photochemical smog** in atmosphere and release ozone. Nitrogen oxide also responsible for **acid rain**. Entry of these nitrogen oxide causes **respiratory trouble** such as emphysema, bronchitis, swelling of lungs and lung cancer etc.
5.	**Sulphur oxide - (SO_2, SO_3)**	Main source of Sulphur oxides are coal burning, smelters, oil refineries.	**Lichen and mosses do not grow in SO_2 polluted areas.** Lichen and mosses are indicator of SO_2 pollution. Sulphur oxides causes chlorophyll destruction. Taj Mahal also get affected.

Smoke – (SO_2, SO_3, NO_2, NO, CO, CO_2)

(B) Secondary Pollutants :

(i) Smog (Smoke + Fog) –

This word was given by Desvoeux. Smog/Smoke is measured by **Ringelmann method**.

Smog is of two types

TG: @Chalnaayaaar

(a) Los Angeles Smog or Photo Chemical smog or Oxidising smog –

It was first observed in Los Angeles. In this process smoke, fog, nitrogen oxide, hydrocarbons, oxygen, UV light and high temperature are essential. These components react with each other and form reddish brown smog (PAN + O_3 + Nitrogen oxides) or brown haze/brown air. Los angles smog is light induced smog.

Effect –

- Photochemical smog causes irritation in eyes and harms the lungs. Due to smog elastic substances (rubber/tyers) also affected.
- Ozone causes harm to mucous membrane.
- During smog peroxyacetyl nitrate (PAN) is formed. PAN stops or inhibits the photolysis of water in hill reaction of photosynthesis and affect or inhibit the photosystem-II. PAN also inhibit the chlorophyll formation in plants.

(b) London smog or sulphur smog or Classical smog or Reducing smog –

It was first observed in London. In this process coal, smoke, fog, sulphur oxide and low temperature are essential. These components react with each other and form vapour (fog) of H_2SO_4 which is known as London smog.

Effect – Due to inhalation of H_2SO_4 vapour with fog 4000 people died in London in 1952.

(ii) Acid rain – This word was given by Robert August. NO_2 and SO_2 released from different sources in form of smoke and dissolved in atmospheric water vapour to form acid (H_2SO_4 + HNO_3). These acids come down on earth with rain water this is called acid rain.

(a) Wet deposition :- If acid comes down on earth with rain, fog and smog, it is known as wet deposition.

(b) Dry depositon :- If acid settled on earth surface through solid dust particles with nitrate or sulphate, this is called dry deposition.

Note : The pH of acid rain is lesser than **< 5.6**

In acid rain the ratio of H_2SO_4 and HNO_3 is **7: 3 (70% H_2SO_4 + 30% HNO_3)**

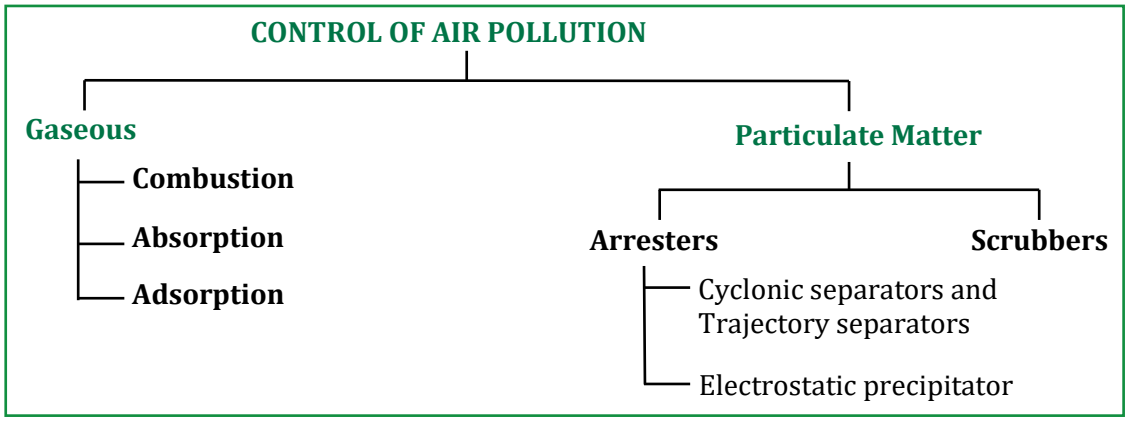
Effects –

Due to acid rain acidity of soil and water increases.

Acid rain also causes damages historical monuments. e.g. Taj Mahal, Red Fort.

Stone leprosy is caused due to acid rain because due to acid rain outer surface of metals, marbles, and stone destroyed.

(C) Control of Air Pollution :



TG: @Chalnaayaaar

(i) **Control of particulate matter –** Two devices used to remove particulate air pollutants are **Arresters & Scrubbers**.

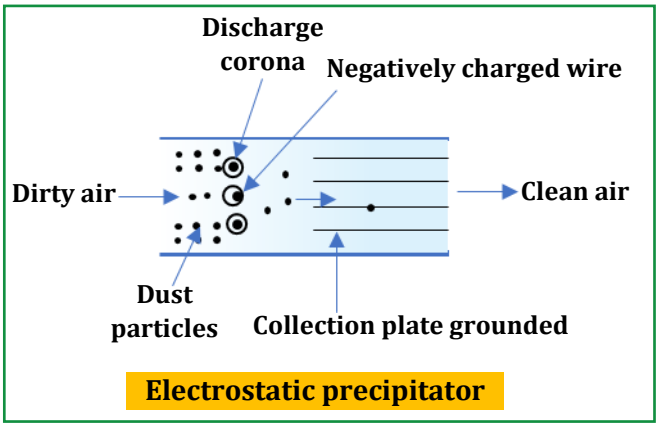
(a) **Arresters :** These are used to separate particulate matters from contaminated air.

Arresters are of different types :

Cyclonic separators and Trajectory separators :- These are commonly used to separate out particulate matters from industrial emissions with minimum moisture content. These separators work on the principle of dust separation by centrifugal force.

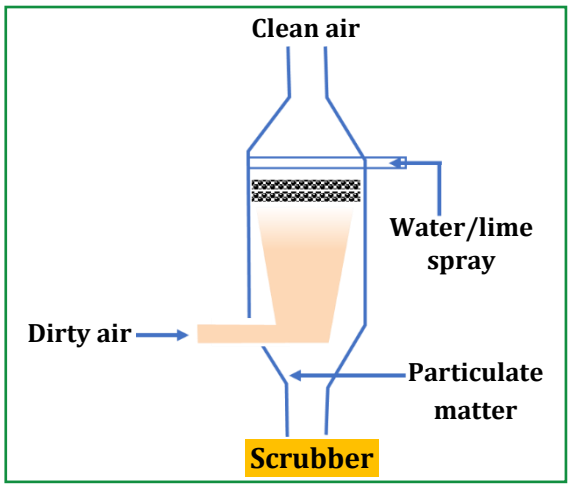
Electrostatic precipitator :- It is the most efficient device to remove fine particulate pollutants. Electrostatic precipitation device work on the principle of electrical charging of the dust particles and collecting it on a differently charged platform.

There are several ways of removing **particulate** matter; the most widely used of which is the **electrostatic precipitator**, which can remove over 99 per cent particulate matter present in the exhaust from a thermal power plant.



It has electrode wires that are maintained at several thousand volts, which produce a corona that releases electrons. These electrons attach to dust particles giving them a net negative charge. The collecting plates attract the charged dust particles. The velocity of air between the plates must be low enough to allow the dust to fall.

(b) **Scrubbers :** A scruber can remove gases like sulphurdioxide. In a scrubber, the exhaust is passed through a spray of water or lime.



(ii) **Control of Gaseous pollutants –** Combustion, absorption and adsorption technique are used to control gaseous pollutants.

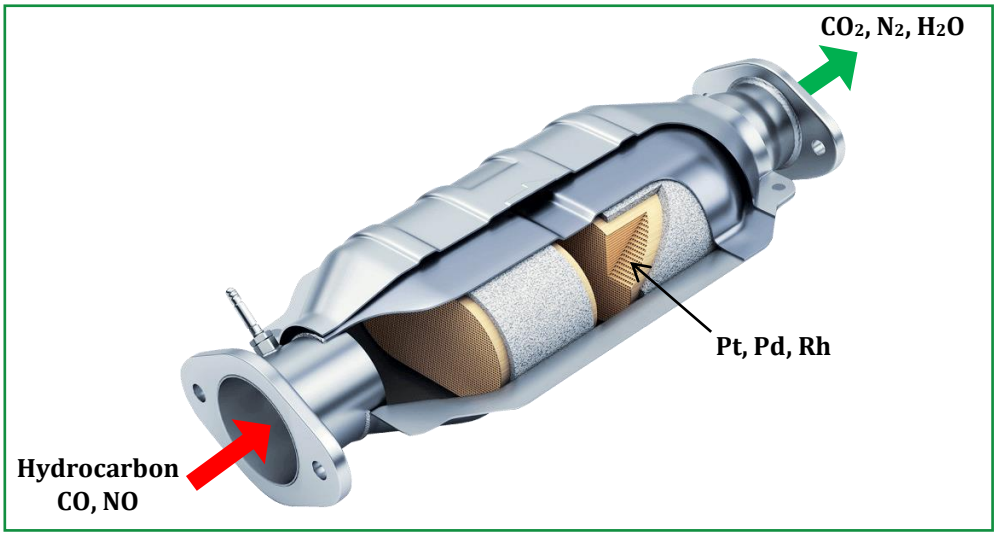
(a) **Combustion –** In combustion process, oxidisable gaseous pollutants are completely burnt at a high temperature. Petrochemical, fertilizer, paints and varnish industries used combustion control of gaseous pollutants.

(b) **Absorption :** Suitable solvents are used to absorbed toxic gaseous pollutants.

TG: @Chalnaayaaar

(c) Adsorption :

Catalytic converters : Automobiles are a major cause for atmospheric pollution in the metro cities. Proper maintenance of automobiles along with use of lead-free petrol or diesel can reduce the pollutants they emit. Catalytic converters, having expensive metals namely **platinum**, **palladium** and **rhodium** as the catalysts, are fitted into automobiles for reducing emission of poisonous gases. As the exhaust passes the catalytic converter, unburnt hydrocarbons are converted into CO_2 and water, and CO and nitric oxide are changed into CO_2 and nitrogen gas respectively. Motor vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalyst.



(iii) A Case study of Delhi –

(a) CNG (compressed natural gas):

In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world.

All the buses of Delhi were converted to run on CNG by the end of 2002.

CNG is the better than diesel because CNG burn most efficiently as compared to diesel or petrol in the automobiles and very little of it is left unburnt. CNG is cheaper than petrol or diesel.

(b) Euro norms: The government of India through a new auto fuel policy has laid out a roadmap to cut down vehicular pollution in Indian cities. More stringent norms for fuels means steadily reducing the sulphur and aromatics content in petrol and diesel fuels.

Bharat stage Norms (Euro norms	Type of Vehicles	Cities	Date of Implementation	Amount of Sulphur in petrol	Amount of Sulphur in diesel	% of hydrocarbon content in fuels
Euro (III)	2,3,4, wheelers	All over India	October 2010	150 ppm	350 ppm	42%
Euro (IV)	4 wheelers	13 Mega cities	April 2010	50 ppm	50 ppm	35%
Euro (IV)	2,3,4 wheelers	All over India	April 2017	50 ppm	50 ppm	35%
Euro (VI)	2,3,4 wheelers	All over India	April 2020	10 ppm	10 ppm	35%

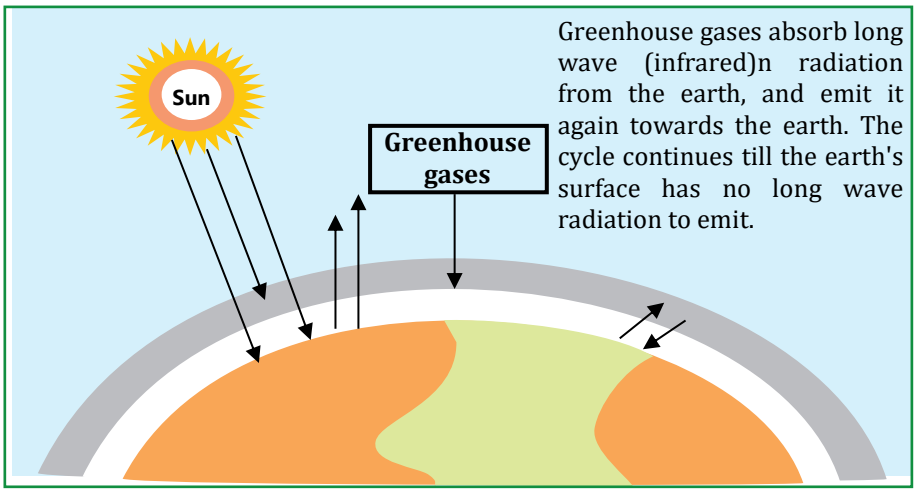
TG: @Chalnaayaaar

TG: @Chalnaayaaar

(D) Green House Effect :

Definition : In this phenomenon cover of CO_2 and other green house gases layer around the earth, allow the short wavelength incoming solar radiation to come in but does not allow the long wavelength of out going heat radiation from warm surface of earth and keep earth warm.

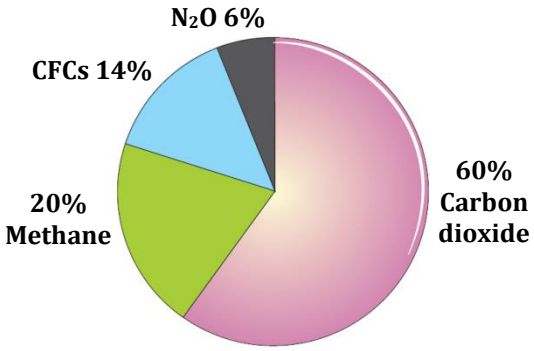
Without greenhouse effect, the average temperature at surface of earth would have been a chilly – 18°C rather than the present average of 15°C.


Sun
Greenhouse gases
Greenhouse gases absorb long wave (infrared)n radiation from the earth, and emit it again towards the earth. The cycle continues till the earth's surface has no long wave radiation to emit.

(i) Green House Gases :

CO_2, CH_4, CFC, N_2O, O_3, water vapour released from industries and NO_2 released from agriculture which are responsible to increase green house effect.

Usually carbon dioxide is not considered as pollutant, but its higher concentration forms a thick layer above the earth's surface, checks the radiation of the heat from the earth surface. Because of this, temperature of the earth's surface increases, this is called **global warming**.



Relative contribution of various greenhouse gases to total global warming

(ii) Effect of increase in amount of Green house gases :

- It has been observed that in the recent past, the level of CO_2 in the atmosphere has increased from 280 ppm to 368 ppm in 1956 to 2002.
- Increase in the level of greenhouse gases has led to considerable heating of Earth leading to global warming. During the past century, the temperature of Earth has increased by 0.6°C, most of it during the last three decades.
- Even 2-3°C rise in temperature will lead to melting of glaciers and ice caps of polar region and consequently the floods in rivers, rise in sea level and changes in cycle of rain. Islands may be submerged in sea water.
- Sea level has been raised by 1 to 2 mm per year during 20th century.
- Odd climate changes like El nino effect. Effect of El nino on India is flood, drought and Monsoon damage.

TG: @Chalnaayaaar

- **Carbondioxide fertilisation effect –** Due to increased CO_2 concentration the rate of photosynthesis will increase (up to a few year). The response of the plants to elevated concentration of CO_2 is known as the CO_2 fertilisation effect.

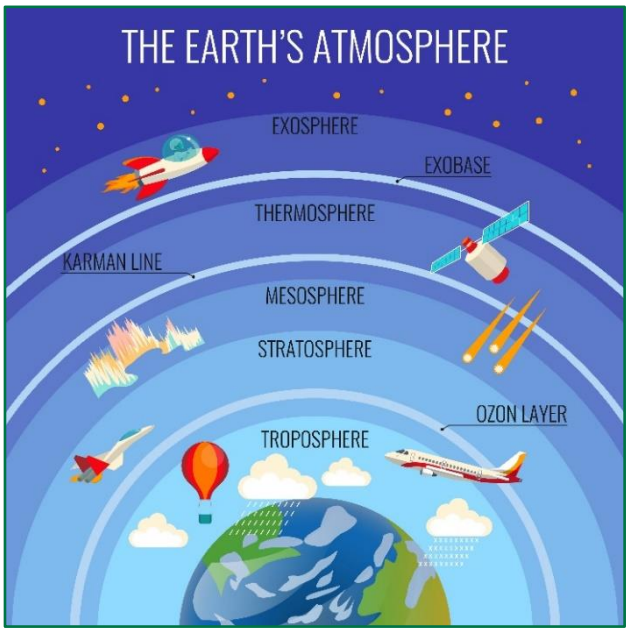
(iii) Measures to control Global Warming:

- Cutting down use of fossil fuel
- Improving efficiency of energy usage.
- Reducing deforestation and planting trees.
- Slowing down human population growth.
- International initiatives like Kyoto protocol and Earth summit.

(E) Ozone Depletion :-

(i) Ozone layer :

- Ozone is present in less quantity in atmosphere. But at the height of **16 km to 25 km** on earth, concentration of ozone is maximum in stratosphere.
- At normal temperature and pressure thickness of ozone layer is **3 mm**. (But at poles thickness of ozone layer is **4 mm**).
- Thickness of ozone layer is measured in Dobson unit (1 Du = 1 ppb)



(ii) Depletion of Ozone layer :

- Ozone hole was first discovered in **1985** over Antarctica by **Nimbus-7** satelite.
- Ozone hole over Antarctica develops each year between late August and early October.

(iii) Ozone depleting substances (ODS) :

- Number of pollutants like CFCs (14% of total depletion), Nitrogen oxides (3.5%), CH_4 and halogens (chlorine) cause depletion of ozone layer Maximum. ODP (ozone depletion potential) is of CFCs due to release of chlorine.
- CFCs are released into atmosphere from refrigerators, air conditioners and jet planes.

(iv) Chemical process of ozone depletion (Chain reaction) :

$$CF_2Cl_2(g) + h\nu \longrightarrow \dot{C}l(g) + \dot{C}F_2Cl(g)$$

$$\dot{C}l(g) + O_3(g) \longrightarrow \dot{C}lO(g) + O_2(g)$$

$$\dot{C}lO(g) + O(g) \longrightarrow \dot{C}l(g) + O_2(g)$$

↑

Active chlorine

Note :

- In this process of **one chlorine atom** convert one lakh O_3 molecules into O_2 by photodissociation.
- The life time of CF_2Cl_2 **(CFC–12)** is 139 year while that for $CFCl_3$ **(CFC = 11)** is about 77 years.

(v) Effect of ozone depletion :

- Due to depletion of ozone layer harmful **UV** radiations are penetrating to the earth which causes **skin cancer (Melanoma)** and also acts as strong mutagens. UV radiation of wavelengths shorter than UV-B, are almost completely absorbed by Earth's atmosphere, given that the ozone layer is intact. But **UV-B** damages **DNA and mutation** may occur. It causes ageing of skin, damage to skin cells and various types of **skin cancers**.
- In human eye, cornea absorbs UV-B radiation, and a high dose of UV-B causes inflammation of cornea, called **snow-blindness, cataract, etc.** Such exposure may permanently damage the cornea. UV radiation causes a disease, **xeroderma pigmentosum.**

(vi) Measures to control ozone depletion :

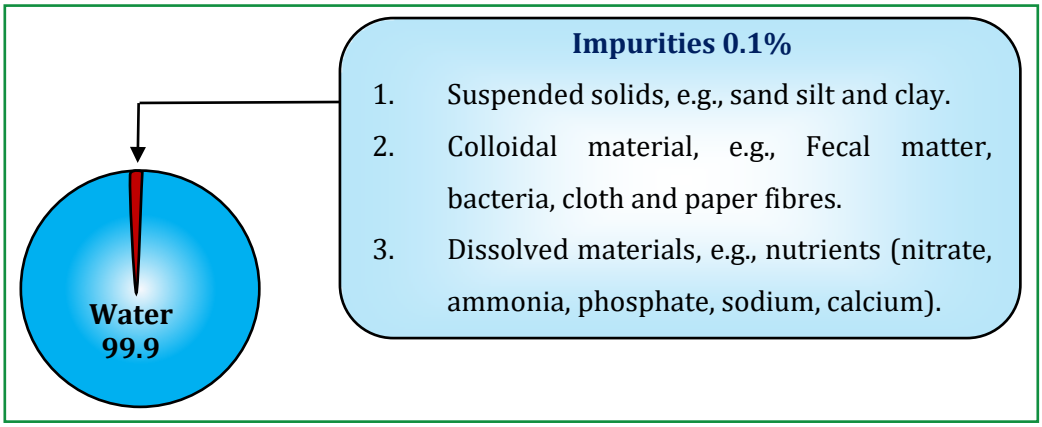
Montreal protocol was signed in 1987 to protect stratospheric ozone. It became effective in 1989.

3. Water Pollution :

The water pollution is caused by the addition of organic and inorganic chemicals as well as the biological materials which change the physical and chemical properties of water. This harmful process is called **water pollution**.

The water pollution is caused by many sources such as sewage matter, industrial wastage, agricultural wastage, domestic wastage, hot water of thermal plant and nuclear reactors etc.

Note : A mere 0.1 per cent impurities make domestic sewage unfit for human use (Figure).

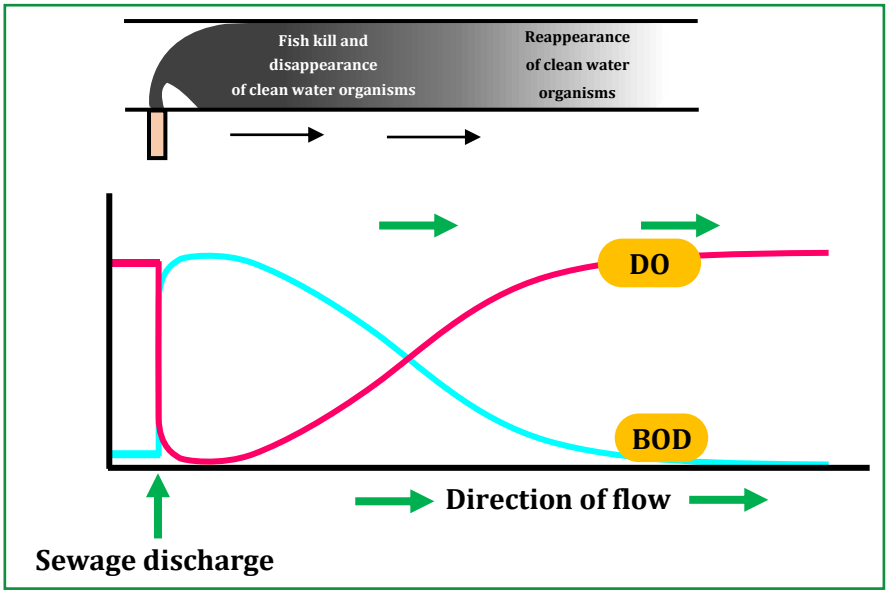

Impurities 0.1%
1. Suspended solids, e.g., sand silt and clay.
2. Colloidal material, e.g., Fecal matter, bacteria, cloth and paper fibres.
3. Dissolved materials, e.g., nutrients (nitrate, ammonia, phosphate, sodium, calcium).
Water
99.9

- Domestic sewage primarily contains biodegradable organic matter.
- Water hyacinth **(*Eichhornia crassipes*)**, the world's most problematic aquatic weed, also called **'Terror of Bengal'.**
- Unlike domestic sewage, waste water from industries like petroleum, paper manufacturing, metal extraction and processing, chemical manufacturing, etc., often contain toxic substance, notably heavy metals (defined as elements with density > 5 g/cm^3 such as mercury, cadmium, copper, lead, etc.) and a variety of organic compounds.

- Water having DO content below **8.0 mgL^{-1}** may be considered as contaminated and below **4.0 mgL^{-1}** heavily polluted.
- DO is measured by **oximeter**.

(A) Biochemical Oxygen Demand (BOD) :

The water pollution by organic wastes is measured in terms of Biochemical oxygen demand. It is the amount of dissolved oxygen **(DO = Dissolved Oxygen)** needed by bacteria in decomposing the organic wastes present in water.



BOD increased = water polluted

BOD $\propto$ input of organic wastes

If B.O.D. is increased dissolved oxygen is decreased in water. Higher amount of organic waste increase the rates of decomposition in water. O_2 is rapidly consumed by microbes, thereby causing drop in DO content in water.

Note : ***Daphnia*** is the indicator of BOD

Note : There is sharp decline in dissolved oxygen downstream from the point of discharge.

(B) Chemical Oxygen Demand (COD) :

COD is the oxygen requirement by chemical $K_2Cr_2O_7$ for oxidation of total organic matter (biodegradable + non-biodegradable) in water.

Note : COD value is always higher than BOD value.

(C) Biological magnification/Bio magnification:

Water ⟶ Phytoplankton ⟶ Zooplankton ⟶ Small fish ⟶ Large fish ⟶ Fish eating birds

DDT– (0.003 ppb) (0.003 ppm) (0.04 ppm) (0.5 ppm) (2 ppm) (25 ppm)

The non-biodegradable pollutant like Al, Hg, Fe, DDT, pesticides, phenolic compound ABS (Alkyl benzene sulphonate) are not decomposed by micro-organisms.

TG: @Chalnaayaaar

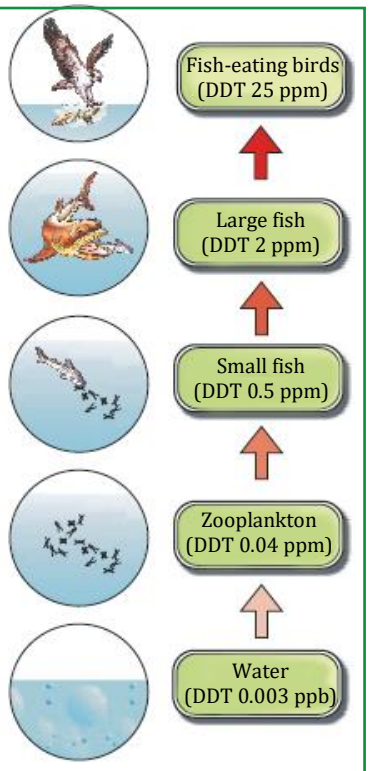
They get accumulated in tissue in increasing concentration along the food chain is called biological magnification. **The highest concentration occurs in top consumer.**

Example :

The concentration of DDT is increased at successive trophic levels; say if it starts at 0.003 ppb (ppb = parts per billion) in water, it can ultimately can reach 25 ppm (ppm = part per million) in fish-eating birds, through biomagnification.

Note : High concentration of DDT distrub calcium metabolism in birds, which causes thinning of egg shell and their permature breaking, eventually causing decline in bird populations.

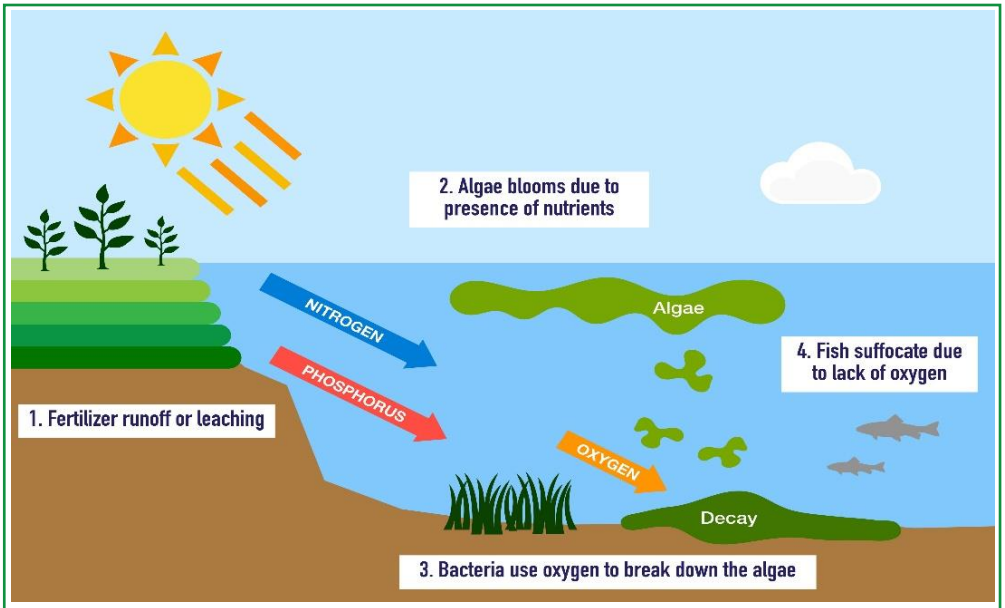
Minamata disease is cause in humans in Japan by biomagnification of mercury (Hg)



Biomagnification of DDT in an aquatic food chain

(D) Eutrophication :-

The process of nutrient enrichment of water and consequent loss of species diversity (or death of aquatic animals) is referred to as eutrophication and lake is known as eutrophic lake. In this process presence of nutrients in lake stimulates growth of algae (algal bloom) increase organic loading and bring about reduction in the oxygen content of water causing death of aquatic animals.



Cultural or Accelerated Eutrophication

TG: @Chalnaayaaar

(i) Effect of eutrophication :

- Eutrophication is the natural aging of a lake by biological enrichment of its water. Natural aging of a lake may span thousands of years and lake finally converted into land due to deposition of silt. Pollutants from man's activities like effluents from the industries and homes can radically accelerate the aging process, this phenomenon is called **accelerated eutrophication or cultural eutophication.**
- During eutrophication due to organic matter lake become **shallow** and **warmer**. Due to warming of lake water, growth of cold water organisms stop and growth of warm water organisms increases.
- B.O.D. of Eutrophic lake is very high.

Types of Lakes :

- **Eutrophic lake –** They are shallow water lakes which contain **high amount of organic materials** and nutrients. They have little O_2 because decomposers rapidly use it up. Chironomus larva are commonly present in it. ***e.g.*** Dal lake of Kashmir
- **Oligotrophic lakes –** These are deep lakes which have **less amount of organic materials and nutrient**.

(ii) Sources : man made pollutant causing eutrophication.

(a) House hold detergents – Phosphate, Nitrate, Sulphate

(b) Industrial waste – Paper industry waste, dairy industry waste, distillery industry waste

(c) Chemical fertilizer – Increasing amount of chemical fertilizer can do to aquatic ecosystem vis-à-vis eutrophication.

(d) Sewage – Sewage contains highest amount of carbonic materials and biological material, as pollutants. These carbonic materials increase the number of decomposers like bacteria and fungus. The acceleration of microbial activity increases BOD of water.

BOD is very less in pure water. The higher BOD is the indication of water pollution and the water of polluted reservoir can not be utilized and very bad smell spreads around the locality. The infections or infectious diseases also takes place.

Sewage treatment :

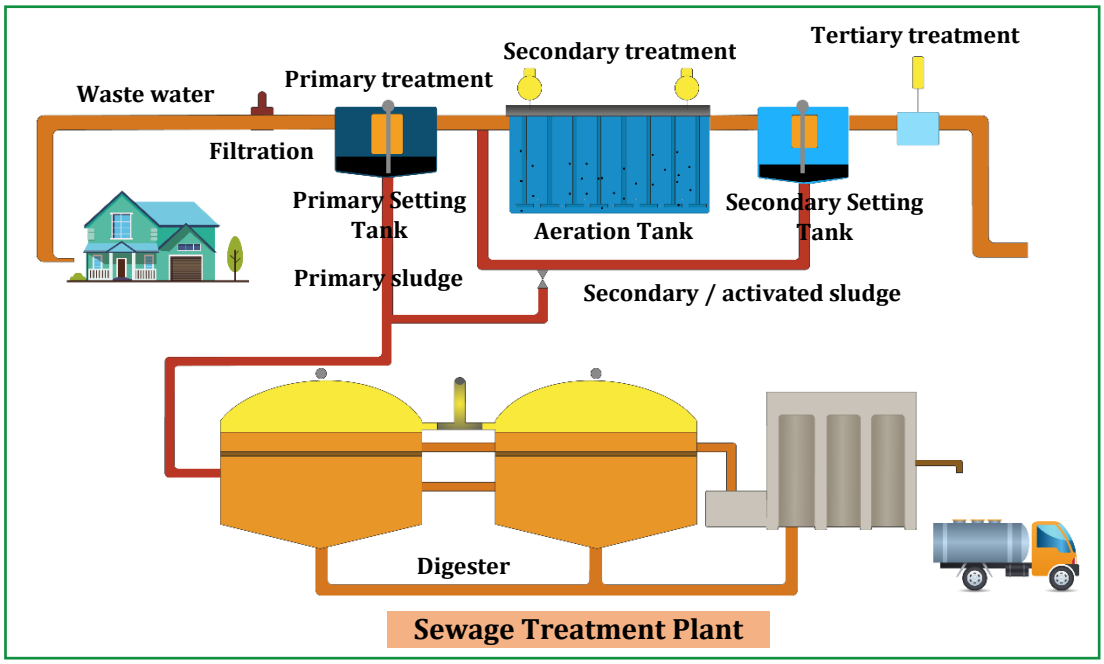
Step-1 : Primary treatment : These treatment steps basically involve physical removal of particles-large and small-from the sewage through filtration and sedimentation. These are removed in stages; initially, floating debris is removed by sequential filtration. Then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle, form the **primary sludge**, and the supernatant forms the effluent or primary effluent. The primary effluent from the **primary settling tank** is taken for secondary treatment.

Step-2 : Secondary treatment or biological treatment : The primary effluent is passed into large aeration tanks where it is constantly agitated (mix) mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into **flocs** (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the primary effluent.

This significantly reduces the **BOD** of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria. The sewage water is treated till the BOD is reduced. The BOD test measures the rate of uptake of oxygen by micro-organisms in a sample of water and thus, indirectly, **BOD is a measure of the organic matter present in the water.** The greater the BOD of waste water, more is its polluting potential.

TG: @Chalnaayaaar

Once the BOD of sewage or waste water is reduced significantly, the effluent or secondary effluent is then passed into a **secondary settling tank** where the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge**. The sludge is pumped into large tanks called **anaerobic sludge digesters**. Here, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.



Sewage Treatment Plant

The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams. The **Ministry of Environment and Forests** has initiated **Ganga Action Plan** and **Yamuna Action Plan** to save these major rivers of our country from pollution. Under these plans, it is proposed to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

Step-3 : Tertiary treatment/Physico-chemical treatment : is used to make potable water.

(E) Water Pollution Indicator :

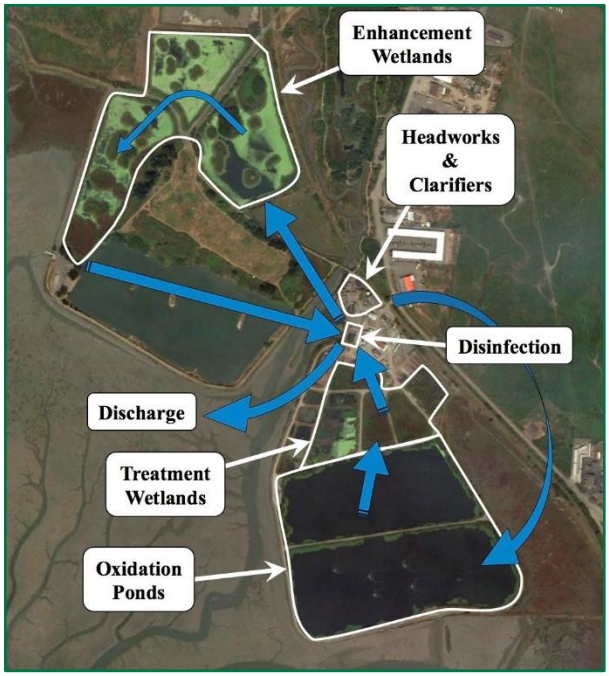
Daphnia, trout fishes and larva of stone fly are the fresh water indicators and Tubifex (an annelid), chironomous larva, *E.coli*, Sewage fungus, Sludge worms, blood worms are the indicator of polluted water.

(F) Thermal waste water :

Heated (thermal) wastewaters flowing out of electricity-generating units, ***e.g.*** thermal power plants, constitute another important category of pollutants. Thermal wastewater eliminates or reduces the number of organisms sensitive to high temperature, and may enhance the growth of plants and fish, which live in high temperature in cold areas but, only after causing damage to the indigenous flora and fauna.

TG: @Chalnaayaaar

(G) A case Study of Integrated Waste Water Treatment :-



Wastewater including sewage can be treated in an integrated manner, by utilising a mix of artificial and natural processes. An example of such an initiative is the town of **Arcata**, situated along the northern coast of California. Collaborating with biologists from the **Humboldt State University**, the townspeople created an integrated waste water treatment process within a natural system.

The cleaning occurs in two stages –

Step 1 : The conventional sedimentation, filtering and chlorine treatments are given. After this stage, lots of dangerous pollutants like **dissolved heavy metals** still remain. To combat this, an innovative approach was taken.

Step 2 : Biologists developed a series of **six connected marshes** over 60 hectares of marshland. Appropriate plants, algae, fungi and bacteria were seeded into this area, which neutralise, absorb and assimilate the pollutants. Hence, as the water flows through the marshes, it gets purified naturally.

The marshes also constitute a sanctuary, with a high level of biodiversity in the form of fishes, animals and birds that now reside there. A citizens group called Friends of the Arcata Marsh **(FOAM)** are responsible for the upkeep and safeguarding of this wonderful project.

(H) Sustainable systems for handling human excreta :

Ecological sanitation is a sustainable system for handling human excreta, using **dry composting toilets**. This is a practical, hygienic, efficient and cost-effective solution to human waste disposal. The key point to note here is that with this composting method, human excreta can be recycled into a resource (as natural fertiliser), which reduces the need for chemical fertilisers. There are working **'EcoSan' toilets** in many areas of **Kerala and Sri Lanka**.

BEGINNER'S BOX-1 — AIR AND WATER POLLUTION

1. Photo-chemical smog is :
(1) $H_2SO_4 + HNO_3$ (2) Vapours of H_2SO_4 (3) PAN + O_3 + NOX (4) PAN + H_2SO_4

2. Due to green house effect, present average temperature of earth is :
(1) –18°C (2) 15°C (3) 0.6°C (4) 25°C

3. Thickness of ozone layer is measured is :
(1) Decibel (2) mg/L (3) PM (4) Dobson unit

4. Heavy metals like mercury, lead, etc have density greater than ..... ?
(1) 5 g/cm^3 (2) 5 mg/cm^3 (3) 25 g/cm^3 (4) 25 mg/cm^3

5. Which among the following refers to the increase in concentration of the toxicant at successive trophic level -
(1) BOD (2) Biomagnification (3) Biofortification (4) Eutrophication

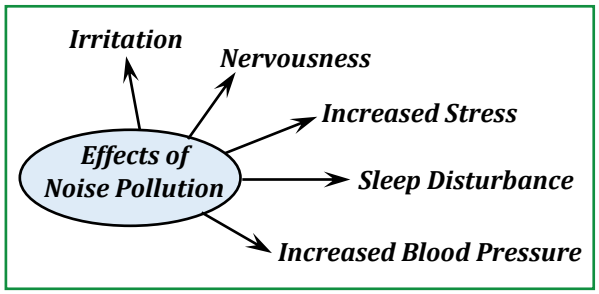
TG: @Chalnaayaaar

4. Sound Pollution :

- Increase in the noise in the atmosphere is called noise pollution or sound pollution. Noise is a loud and unwanted or unpleasant sound. The common things which are responsible for noise pollution are - industries and mills, means of transportation, television stereo, loud speaker and jet plant etc.

Intensity :- The intensity of sound is measured in **bel or decibel** [1 bel = 10 decibel]. Normally at 25 decibel, the atmosphere may be peaceful. Above **80** decibel intensity of sound is called noise pollution.

Note : In India, the Air (Prevention and Control of Pollution) Act came into force in **1981**, but was amended in **1987** to include noise as an air pollutant.



- Noise is undesired high level of sound. We have got used to associating loud sounds with pleasure and entertainment not realising that noise causes psychological and physiological disorders in humans. The bigger the city, the bigger the function, the greater the noise!! A brief exposure to extremely high sound level, 150 dB or more generated by take off of a jet plane or rocket, may damage ear drums thus permanently impairing hearing ability. Even chronic exposure to a relatively lower noise level of cities may permanently damage hearing abilities of humans. Noise also causes sleeplessness, increased heart beating, altered breathing pattern, thus considerably stressing humans.

- Reduction of noise in our industries can be affected by use of sound absorbent material or by muffling noise. Like green muffler.
- **Green muffler scheme** – Tree such as **neem** and **ashoka** absorb sound to a great extent, along road side.

Very Quiet	20 – 30 dB	Sound quiet place is – 20 dB, Motion Picture studio, Broadcasting studio
Silence/Quiet	30/35 – 50 dB	Hospitals (30 – 35), Schools (45 – 50), Libraries (45 – 50), Offices (40 – 50)
Normal voice	55 dB	
Conversational speech	60 dB	
Moderately Loud	70 dB – 90 dB	Average traffic – 70 dB Heavy city traffic – 90 dB
Uncomfortable Painful	above 100 dB above 130 dB	Air craft (120 dB) Rocket (180 dB) Jet plane (150 dB)

TG: @Chalnaayaaar

5. Solid Waste Pollution :

Solid wastes refer to everything that goes out in trash. Municipal solid wastes are wastes from homes, offices, stores, schools, hospitals, etc., that are collected and disposed by the municipality. The municipal solid wastes generally comprise paper, food wastes, plastics, glass, metals, ruber, leather, textile, etc. Burning reduces the volume of the wastes, although it is generally not burnt to completion and open dumps often serve as the breeding ground for rats and flies. **Sanitary landfills** were adopted as the substitute for open-burning dumps. In a sanitary landfill, wastes are dumped in a depression or trench after compaction, and covered with **dirt everyday**.

Open dumps

Sanitary land fill

(A) Control of solid waste :-

(i) **House hold waste** → Landfills and incineration.

(ii) **Hospital waste** → Incineration

(iii) **Incineration** → Solid wastes burning in presence of oxygen. The use of incinerators is crucial to disposal of hospital waste

(iv) **Pyrolysis** → Solid wastes burning (combustion) in the absence of oxygen.

(v) **Electronic waste** → is also called e-wastes. Irreparable computers and other electric goods are known as electronic wastes (e-wastes). E-wastes are buried in landfills or incinerated. Eventually recycling is the only solution for the treatment of e-wastes.

Note : Landfills are also not really much of a solution since the amount of garbage generation specially in the metros has increased so much that these sites are getting filled too. Also there is danger of seepage of chemicals, etc. from these landfills polluting the underground water resources.

(B) Case Study of Remedy for Plastic Waste :-

- **Ahmed Khan**, aged 57 years old and plastic sac manufacturer has been producing plastic sacks for 20 years. About 8 years age, he realised that plastic waste was a real problem. **Polyblend**, a fine powder of recycled modified plastic, was developed then by his company. This mixture is mixed with the **bitumen** that is used to lay roads.
- In collaboration with R.V.College of Engineering and the Bangalore City Corporation, Ahmed Khan proved that blends of Polyblend and bitumen, when used to lay roads, enhanced the bitumen's water repellent properties, and helped to increase road life by a factor three. The raw material for creating Polyblend is any plastic film waste.

TG: @Chalnaayaaar

6. Radioactive Pollution :

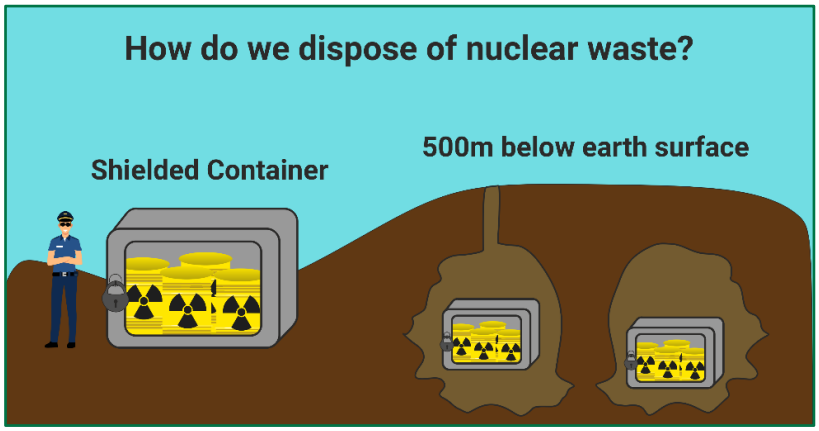
The various sources of radioactive materials as follows

(A) **Natural Sources :** Cosmic rays, radiation from the earth such as Radium - 224, Uranium 235, Uranium 238, Thorium 232, Radon 222.

(B) **Man Made Radiation :** The radiations are released in the atmosphere during mining and purification of Thorium and Plutonium, and in producing nuclear weapons etc.

Nuclear reactor and nuclear fuel causes pollution by radioactive radiation. The nuclear fuel and coolants are the sources of radioactive radiation. Radioactive waste is also most important radio active pollutants because these wastes are not dumped at particular or right place.

(C) **Other Sources :** Some of the radioactive elements (isotops) are used in experimental laboratories for scientific researches which causes radio active pollution. X-rays are also proved to have harmful effects.



Note :-

- The first is accidental leakage of radiation occurred in the **Three Mile Island** and **Chernobyl**.
- It has been recommended that storage of nuclear waste, after sufficient pre-treatment, should be done in suitably shielded containers buried within the rocks, about **500 m deep** below the earth's surface.

7. Other Information :

(A) **MIC [Methyl Isocyanate]** was released in Bhopal gas tragedy on **3rd December 1984**. Which is used in the production of "Savin" insecticide in Union Carbide factory.

(B) **Tetraethyl lead** [$Pb(C_2H_3)$] and tetramethyl lead [$Pb(CH_3)_4$] are formed by combustion of petroleum. They are known to hamper haemoglobin formation.

- The disease produced by use of lead polluted water is called as **Plumbism**.
- Lead causes nervousness anaemia in human beings. It also damages kidney.
- Lead concentration in blood is considered alarming if it is 10 μg/ 100 ml.

(C) **Pneumoconiosis** : Common dust disease

- Disease due to cotton dust in textile workers is – **Lung fibrosis or Byssinosis**
- Disease due to coal dust – **Anthracosis**
- Disease due to asbestos dust – **Asbestosis**
- In stone grinders disease due to silica dust – **Silicosis**
- In Iron mill disease due to iron dust – **Siderosis**

TG: @Chalnaayaaar

(D) **Blue Baby Disease :** This disease is caused by the high amount of nitrate in water. It is also known as **Methaemoglobinaemia** or **Cyanosis**.

(E) **Hypertension and Uremia** – Caused by Copper

(F) **Arsenic :** It causes black-foot disease and poisoning in fodder plants which are eaten by live stock and causes their death.

(G) **Cadmium :** causes anaemia, hypertension, damage to liver and kidneys. In Japan it caused bone softening or skeleton deformity called **Itai-Itai disease or Ouch-Ouch.**

(H) **Fluorides** :- The higher concentration of fluorides causes chlorosis or necrosis in tips and margin of leaf (leaf lamina). The compounds of fluorine reach in the animals through the fodder and causes abnormal calcification of teeth, this is called **Fluorosis.**

Note : The experts hold that the maximum level of fluoride which the human body can tolerate is **1.5 parts per million[ppm].** When ingested in excess over a long period of time causes "Fluorosis".

(I) **ELNino effect** - It is the process in which water of Pacific ocean get warm, in this process warm water current flows to Ecuador & Peru in between 5 to 8 year at Christmas time. **Effect of ELNino is flood, drought** and **monsoon damage in India.** On the other hand when cold water comes in effect in pacific ocean it is called **La-Nina** effect.

(J) Major pollutant in Jet plane emission is CFC.

(K) **Third pollution or land scape pollution :** To make Fertile-land barren by dumping wastes ***e.g.***, ash, industrial waste

(L) **Flu gas –** Gas which is released from chimnies.

(M) **Plume –** Smoke which is released from chimnies.

(N) **Phytotrons –** A such type of house where plants are grown in controlled environment.

(O) **Hydrocarbon –** Are also known as volatile organic carbons (VOC).

(P) Ganga Action plan for controlling pollution in ganga (1985) included city : (i) Kolkata (ii) Kanpur.

(Q) At 50 ppm, CO converts 7.5% of haemoglobin in to carboxy haemoglobin with in 8 hours.

(R) Maximum green house gas released by – China.

(S) Cotton dust is an important pollutant in Ahmedabad.

(T) **Environment law for controlling pollution :**

(i) **The National Environment (Protection) Act (NEPA) 1986 :-**This act clearly brings the protection of water and soil quality, and the control environmental pollutants.

(ii) **The insecticide Act, 1968 :-** This act deals with the regulation of import, manufacture, sale, transport, distribution and use of insecticides with a view of preventing risk to human health and other organisms.

(iii) **The water (Prevention and control of pollution) Act, 1974 :-** This act deals with the preservation of water quality and the control of water pollution with a concern for the detrimental effects of water pollutants on human health.

(iv) **The air (Prevention and control of Pollution) Act, 1981 :-** This act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental effects of air pollutants on human health and also on the biological world. Noise was added as air pollutant by an amendment in 1987.

TG: @Chalnaayaaar

TG: @Chalnaayaaar

Important Informations :

- Conference on human environment in 1972 held at Stockholm.
- Recognising the deleterious affects of ozone depletion, an international treaty, known as the **Montreal protocol** was signed in 1987 Montreal (canada) 27 industrialised countries signed the Montreal protocol to protect **stratospheric ozone**. It's effective in 1989. More than 175 countries have signed the montreal protocol.
- UNCED (United Nations Conference on Environment and Development) Earth Summit held at Rio-de-Jenerio (Brazil) in 1992 for reducing green house gases & **biodiversity conservation** and make Agenda-21.
- Kyoto protocol conference held in **Kyoto** (Japan) for **climate change** (1997). This protocol requires countries to take appropriate measures to reduce their overall green house gas emisson to a level at 5 percent below the 1990 level by the commitment period 2008-2012.
- **World summit** on sustainable development **(2002)** was held in **Johannesburg (S. Africa).**

(U) Important dates about environmental issues :

* COP = Conference of the parties
* UNCED = June 1992 (Adopted) / March 1994 (Effective)

	Meeting	Date	Venue
1	COP-1	March 1995	Berlin, Germany
2	COP-3	Dec 1997	Kyoto, Japan (Adopted the Kyoto Protocol)
3	COP-11	Dec 2005	Montreal, Canada (Implemented the Kyoto Protocol)
4	COP-17	28 Nov- 9 Dec-2011	Durbon/South Africa
5	COP-18	26 Nov- 7 Dec-2012	Doha/Qatar (Amendment of Kyoto Protocol, Extended upto 2020)
6	COP-19	22 Nov-2013	Warsaw/Poland
7	COP-20	12 Dec.-2014	Lima/Peru
8	COP-21	30 Nov- 11 Dec -2015	Paris/France
9	COP-22	07 Nov- 18 Nov -2016	Marrakesh, Morocco
10	COP-23	6 Nov - 17 Nov -2017	Bonn, Germany
11	COP-24	2 Dec - 14 Dec - 2018	Katowice, Poland
12	COP-25	2 Dec - 13 Dec - 2019	Madrid, Spain
13	COP-26	31 Oct - 12 Nov – 2021	Glasgow, Scotland

8. Effect of Agro Chemicals and Improper Resource Utilisation :

- In the wake of green revolution use of agrochemicals like inorganic fertilizers and pesticides, weedicides, fungicides etc. has increased manifold for enhancing crop production. It harms the non-targeted organisms important component of the soil ecosystem.
- The action of pollutants and improper resource utilization like unrestricted grazing, deforestation and poor irrigation practise increase **soil erosion** and **desertification**.
- Irrigation without proper drainage of water leads to **water logging** which results in increase in **soil salinity**.

TG: @Chalnaayaaar

9. Case Study of Organic Farming :

- Integrated organic farming is a cyclical, **zero-waste procedure**, where waste products from one process are cycled in as nutrients for other processes.
- This allows the maximum utilisation of resource and increases the efficiency of production. **Ramesh Chandra Dagar**, a farmer in **Sonipat**, **Haryana**, is doing just this. He includes bee-keeping, dairy management, water harvesting, compositing and agriculture in a chain of processes, which support each other and allow an extremely economical and sustainable venture.
- There is no need to use chemical fertilisers for crops, as cattle excreta (dung) are used as manure. Crop waste is used to create compost, which can be used as a natural fertiliser or can be used to generate natural gas for satisfying the energy needs of the farm.
- Enthusiastic about spreading information and help on the practice of integrated organic farming. Dagar has created the **Haryana Kisan Walfare Club**, with a current membership of 5000 farmers.

★ Golden Key Points ★

- Automobiles are the major cause of pollution in metro cities.
- Composition of acid rain – **70% (H_2SO_4)** and **30% (HNO_3)** and **pH < 5.6**
- Green house effect is a natural phenomenon responsible for heating of atmosphere and earth's surface.
- Most efficient method for removing particulate matter from exhaust is **Electrostatic precipitator (ESP)**
- **According to Euro norms-IV Sulphur content should be reduced to 50 ppm in Petrol and Diesel.**
- Good ozone (responsible UV absorption) is present in stratosphere whereas bad ozone (Pollutant) is present in Troposphere.
- Maximum concentration of non-biodegradable pollutants occur in top consumers **(Biological magnification)**
- Nutrient enrichment leading to **natural ageing** of lake is called **Eutrophication.**
- Increases pollutants due to human activities can accelerate ageing of lake called accelerated or cultural eutrophication.
- **Pollution $\propto$ BOD $\propto$ organic matter $\propto \frac{1}{DO}$**
- National forest policy **(1988)** in India recommended **33%** of forest cover for plains and 67% of forest cover for hills.
- Ecological sanitation is sustainable system for handling human excreta by dry composting.
- Polyblend is a fine powder of recycled modified plastic and raw material for creating it is any plastic film waste.
- For two wheelers, Bharat stage IV is applied all over India since 1st April, 2017.

TG: @Chalnaayaaar

BEGINNER'S BOX-2 ENVIRONMENTAL ISSUES

1. Which of the following is also called "Terror of Bengal" –

(1) Water hyacinth (2) Water lily

(3) African catfish (4) *E.coli*

2. Gas released during Bhopal gas tragedy was :

(1) Ozone (2) Methane

(3) Methyl isocyante (4) Alkyl benzene sulphonate

3. How E-waste are treated without damage to environment and human life?

(1) Recycling (2) Buried in pit / landfills

(3) Incinerated (4) All of these

4. Polyblend is obtained by which of the following-

(1) By making a paste of recycled modified plastic

(2) By making a powder of recycled modified plastic

(3) By making a paste of non-recycled unmodified plastic

(4) By making a powder of non-recycled unmodified plastic

5. Who was the founder of Haryana kisan welfare club ?

(1) Suresh Dagariya (2) Raju Chandra Bhushan

(3) Ahmad Khan (4) Ramesh Chandra Dagar

BEGINNER'S BOX ANSWERS KEY

BEGINNER'S BOX-1	Que.	1	2	3	4	5
	Ans.	3	2	4	1	2

BEGINNER'S BOX-2	Que.	1	2	3	4	5
	Ans.	1	3	4	1	4

TG: @Chalnaayaaar

Air Pollutants
- Gases like CO, CO_2, NO, NO_2, SO_2, SO_3
- Particulate matter of Size 2.5 μm or less

Secondary Pollutants
- Photo chemical smog (PAN + O_3 + NO_2)
- Classical Smog (H_2SO_4Vapours)
- Acid rain.

Air pollution and Control

Control
- Electrostatic precipitator (99% efficiency)
- Scrubber
- Catalytic converter
- Euro Norms (Bharat stage norms)

Greenhouse effect
- CO_2, CH_4, CFC, N_2O are major greenhouse gases.
- Increase in CO_2 leads to global warming.
- Kyoto protocol and Earth summit for reduction of of green house.

Ozone depletion
- Ozone in stratosphere protects us from UV rays.
- CFC have ozone depletion potential.
- Montreal Protocol to protect ozone.

Water pollution
- Higher the pollution, higher is BOD
- As BOD increases Dissolved O_2 decreases.
- Pesticides like DDT, heavy metals like Hg cause Bio magnification.
- Nutrients like Nitrate and Phosphate cause Eutrophication.
- Death of aquatic animals in Eutrophic lake.

Sewage Treatment